

IN THE CLAIMS:

Kindly cancel claims 20 and 22-24 without prejudice or disclaimer recited thereof.

Kindly amend the following claims:

1.(Amended) A bump forming apparatus for charge appearance semiconductor substrates which is equipped with a bump forming head for forming bumps onto electrodes of a circuit on the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change in a state while heated to a bump bonding temperature necessary for forming the bumps,

said bump forming apparatus comprising:

a heating and cooling apparatus for eliminating electric charge generated to the substrate as a result of a decrease in temperature in cooling the substrate after bumps are bonded to the heated substrate; and

a controller for executing a decrease in temperature control for cooling the substrate after the bonding to the heating and cooling apparatus.

2.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 1, wherein, when executing the cooling, the heating and cooling apparatus comes in contact with a rear face opposite to a front face as a circuit-formed face of the charge appearance semiconductor substrate so as to eliminate charge generated to the substrate because of the decrease in temperature in the cooling.

4.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 3, wherein the heating and cooling apparatus comprises a bump bonding stage for heating the substrate to the bump bonding

temperature, and a cooling device for cooling the substrate in accordance with the decrease in temperature control by the controller.

5.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 3, wherein the heating and cooling device comprises a bump bonding stage for heating the substrate to the bump bonding temperature, and a preheat device for preheating the substrate in accordance with the temperature rise control by the controller.

6.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 4, wherein the cooling device includes a heat diffuser member which comes in contact with the rear face of the substrate, a heating part detachable to the heat diffuser member for raising the heat diffuser member in temperature, and a separator for separating the heat diffuser member and the heating part so as to promote cooling of the heat diffuser member.

7.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 5, wherein the preheat device includes a heat diffuser member which comes in contact with the rear face of the substrate, a heating part which comes in contact with the heat diffuser member so as to raise the heat diffuser member in temperature, and a separator for separating the heat diffuser member and the heating part so as to promote cooling of the heat diffuser member.

8.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 2, which further comprises a gas supply device for supplying a gas to the substrate placed to the heating and cooling apparatus,

A2
enc

wherein the controller executes a warpage correction control for correcting a warpage generated to the substrate placed to the heating and cooling apparatus to either the gas supply device, or the heating and cooling apparatus.

10.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 2, which further comprises a contact member for charge removal which comes in contact with the front face of the substrate to remove an amount of charge generated to the front face.

11.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 2, which further comprises an ion generator for generating ions for neutralizing charge accumulated to the substrate.

A 3
10039700-010292

12.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 11, which further comprises a wafer holding part with holding hooks for holding the substrate by the holding hooks and transferring the substrate to the heating and cooling apparatus, wherein the wafer holding part and the holding hooks are coated with an insulating material at a portion where the ions generated from the ion generator act.

13.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 2, wherein the heating and cooling apparatus is metal plated at a portion in contact with the rear face of the substrate for improving a heat conductivity between the heating and cooling apparatus and the substrate and removing charge of the substrate.

A4

17.(Amended) The charge removal method for charge appearance semiconductor substrates according to claim 14, further comprising:

eliminating charge generated to a circuit-formed face of the substrate by bringing a contact member for charge removal into contact with the circuit-formed face of the substrate.

18.(Amended) A charge removing unit it for charge appearance semiconductor substrates, which comprises:

heating and cooling apparatus which comes in contact with a rear face opposite to face as circuit-formed face of the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change, thereby removing electric charge generated to the substrate as a result of a decrease in temperature in cooling the substrate after heating the substrate; and

a controller for executing a decrease in temperature control for cooling the substrate to the heating and cooling apparatus.

19.(Amended) A charge appearance semiconductor substrate which comprises:

a region for charge removal which is formed to a front face as a circuit-formed face of the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change, and which is formed of a conductor for eliminating electric charge generated to the substrate; and

dicing lines, connected to the region for charge removal, for dicing circuit-formed parts formed to the front face from the substrate.

21.(Amended) A charge appearance semiconductor substrate, which has an amount of electric charge of not larger than $\pm 200V$ because of eliminating electric charge generated to the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change.

29.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 25, wherein the heating and cooling apparatus has a bump bonding stage for heating the substrate to the bump bonding temperature and a cooling device for cooling the substrate in accordance with the decrease in temperature control by the controller.

30.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 27, wherein the heating and cooling apparatus has a bump bonding stage for heating the substrate to the bump bonding temperature and a preheat device for preheating the substrate in accordance with the temperature rise control by the controller.

31.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 29, wherein an ion generator for generating ions to neutralize charge of the substrate and acting the ions to the substrate is arranged opposite to the substrate placed to the cooling device.

32.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 31, wherein the heating and cooling apparatus includes the bump bonding stage for heating the substrate to the bump bonding temperature and a preheat device for preheating the substrate to a vicinity of the bump bonding temperature in a noncontact state to the substrate before heating the substrate to the bump bonding temperature, said preheat device being subjected to a temperature rise control by the controller for removing charge generated to the substrate as a result of the temperature rise in the preheating, with the ion generator arranged opposite to the substrate disposed to the preheat device.

33.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 31, which further has a wafer holding part with holding hooks for holding the substrate, thereby holding and transferring the substrate by the holding hooks to the heating and cooling apparatus, wherein the wafer holding part and the holding hooks are coated with an insulating material at a portion where the ions generated from the ion generator act.

34.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 29, wherein the cooling device has a heat diffuser member which is arranged opposite to the substrate and has a far infrared radiation paint applied to a face opposite to the substrate.

35.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 30, wherein the preheat device has a heat diffuser member which is arranged opposite to the substrate and has a far infrared radiation paint applied to a face opposite to the substrate.

36.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 29, which further includes a warpage correction device connected to the bump bonding stage for correcting a warpage of the substrate loaded to the bump bonding stage.

38.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 29, which further has a gas supply device connected to the bump bonding stage for supplying a gas to eliminate charge charged to the substrate loaded to the bump bonding stage, wherein the controller further executes a gas supply control for charge removal to the gas supply device.

39.(Amended) The bump forming apparatus for charge appearance semiconductor substrates according to claim 25, which further includes a contact member for charge removal which comes in contact with a front face as a circuit-formed face of the substrate so as to eliminate an amount of charge generated to the front face of the substrate.

A7
en
40.(Amended) A method for removing charge of charge appearance semiconductor substrates which is carried out by a bump forming apparatus, the method comprising:

forming bumps to electrodes formed in a circuit on the substrate which generates electric charge in consequence of a temperature change with the substrate heated to a bump bonding temperature necessary for forming the bumps; and

after the bump-forming, when the substrate is cooled with use of a cooling device arranged in a non-contact state to the substrate for heating the substrate thereby adjusting a decrease in temperature of the substrate, executing a decrease in temperature control for eliminating electric charge generated as a result of the decrease in temperature in cooling the substrate to the cooling device.

42.(Amended) A charge removing unit for charge appearance semiconductor substrates, which comprises:

A8
a controller for executing a decrease in temperature control to eliminate electric charge generated as a result of a decrease in temperature in cooling after heating the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change; and

a heating and cooling apparatus for heating the substrate in a non-contact state to the substrate and cooling the substrate in accordance with the decrease in temperature control by the controller after the cooling.

Kindly add the following new claim:

44.(NEW) A method for removing charge of charge appearance semiconductor substrates, which comprises:

bringing a charge appearance semiconductor substrate into contact with a contact member for charge removal; and

eliminating electric charge generated to the substrate,

wherein the charge appearance semiconductor substrate comprises a region for charge removal which is formed to a front face as a circuit-formed face of the charge appearance semiconductor substrate which generates electric charge in consequence of a temperature change, and which is formed of a conductor for eliminating electric charge generated to the substrate, and dicing lines, connected to the region for charge removal, for dicing circuit-formed parts formed to the front face from the substrate, and

wherein the contact member for charge removal comes in contact with the front face of the substrate to remove an amount of charge generated to the front face.